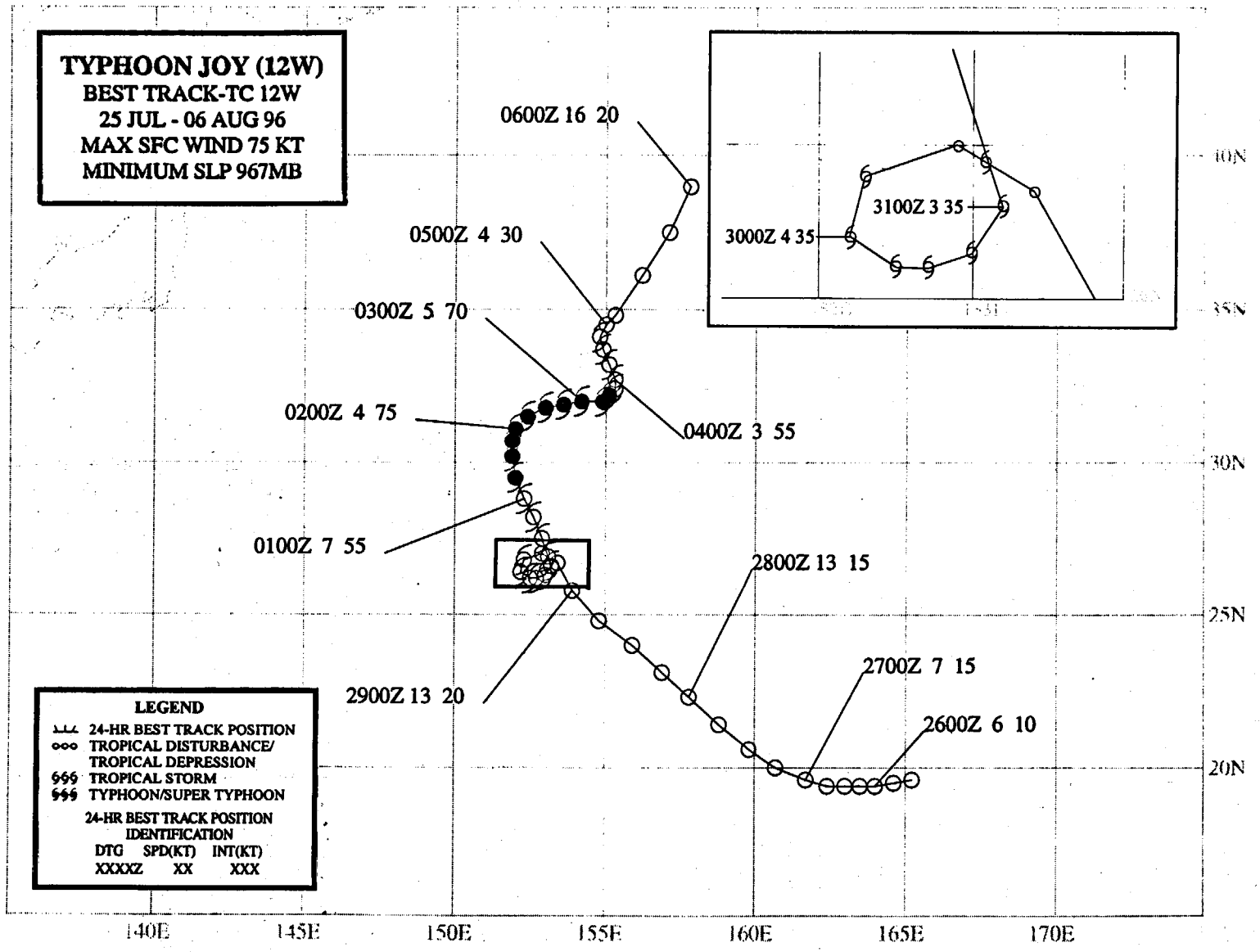
TYPHOON JOY (12W)
BEST TRACK-TC 12W
25 JUL - 06 AUG 96
MAX SFC WIND 75 KT
MINIMUM SLP 967MB
0600Z 16 20
0500Z 4 30
0300Z 5 70
0200Z 4 75
0400Z 3 55
0100Z 7 55
2800Z 13 15
2700Z 7 15
2900Z 13 20
2600Z 6 10
3100Z 3 35
3000Z 4 35
LEGEND
24-HR BEST TRACK POSITION
TROPICAL DISTURBANCE/ TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON/SUPER TYPHOON
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XXX
140E
145E
150E
155E
160E
165E
170E
10N
35N
30N
25N
20N

TYPHOON JOY (12W)

I. HIGHLIGHTS

Joy formed at a relatively high latitude in direct association with a TUTT cell, and did not become a typhoon until it had moved to nearly 30°N. Prevented from recurving by a blocking high, the system moved slowly on a meandering north-oriented track.

II. TRACK AND INTENSITY

During the final week of July, a monsoon trough became established across the WNP, and three tropical cyclones formed simultaneously in this trough — Frankie (08W), Gloria (09W), and Herb (10W). Several days later, Ian (11W) and Kirk (13W) also formed at the eastern end of this monsoon trough. During the time this activity was occurring in the monsoon trough, a TUTT cell (that was first detected near the international date line), was moving slowly westward along 20°N. The tropical disturbance which became Joy originated directly from deep convection associated with this TUTT cell (see the discussion section for more details). On 27 July, deep convection associated with this TUTT cell increased, cirrus outflow became organized into a well-defined anticyclonic pattern, and visible satellite imagery indicated that a low-level circulation had formed, which led to its inclusion on the 270600Z July Significant Tropical Weather Advisory. Comments on this advisory included:

". . . An area of convection is located near 21N 160E. Visible satellite imagery indicates the presence of a low-level cyclonic circulation beneath well-defined anticyclonic flow aloft. Water vapor imagery also indicates that a [TUTT] cell is located to the south of the disturbance. . . ."

The TUTT cell continued its westward motion for the next two days, and the convection located to its north remained poorly organized until 29 July when a small area of deep convection persisted near the estimated low-level circulation center. The first warning on Tropical Depression (TD) 12W was issued valid at 290600Z based on a satellite intensity estimate of 25 kt (13 m/sec). Upgrade of TD 12W to Tropical Storm Joy occurred on the warning valid at 300000Z, based upon a satellite intensity estimate of 35 kt (18 m/sec).

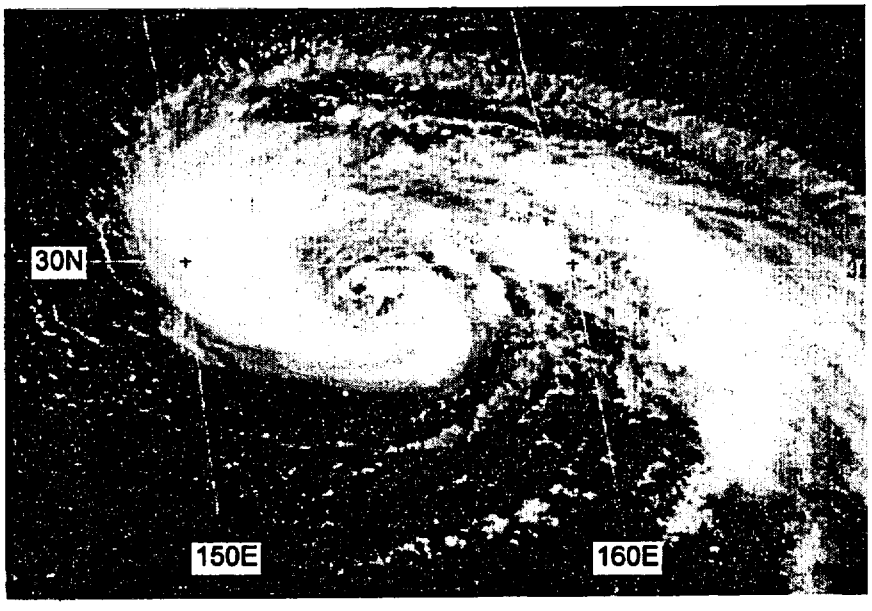

Figure 3-12-1 Joy's primary band of deep convection coils into a banding-type eye (010331Z August visible GMS imagery).

Between 29 and 30 July, Joy remained nearly stationary in weak steering before intensifying as it began moving slowly toward the north-northwest on 31 July. During the daylight hours of 01 August, Joy became well-organized, and its primary band of deep convection became tightly coiled to form a banding-type eye (Figure 3-12-1). This prompted the JTWC to upgrade Joy to a typhoon on the warning valid at 010600Z September.

Meandering slowly northward, Joy reached its peak intensity of 75 kt (39 m/sec) at 011800Z (Figure 3-12-2).

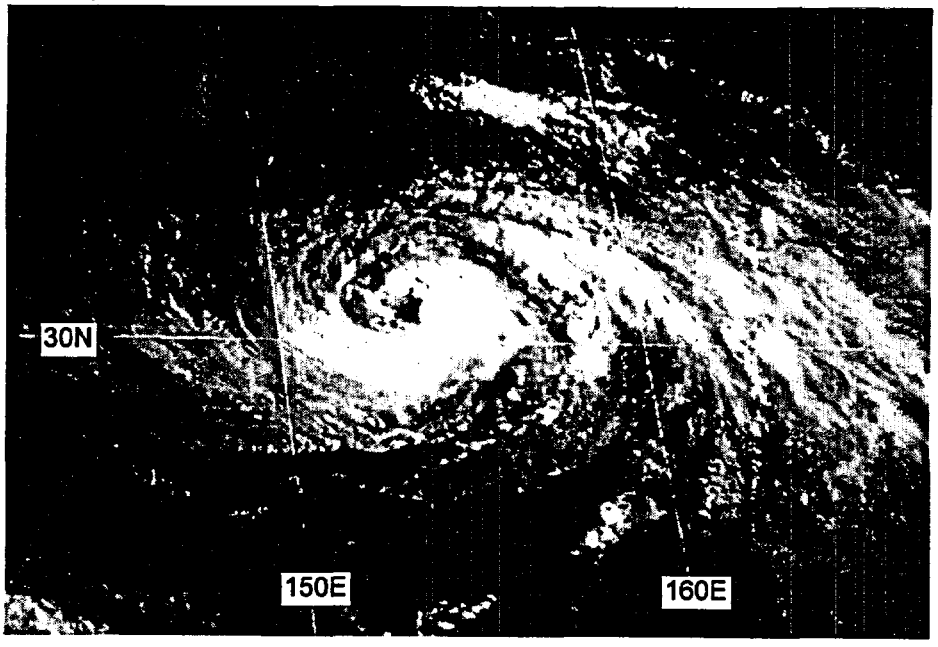

Figure 3-12-2 Joy at its peak intensity of 75 kt (39 m/sec) (012131Z August visible GMS imagery).

Continuing its slow northward drift, Joy began to shear on 04 August. On 05 August, Joy still had some deep convection located to the east of its exposed LLCC, but it had begun to accelerate toward the north-northeast as it interacted with a slow moving north-south oriented frontal cloud band. Expecting Joy to merge with the frontal cloud band and become extratropical, the JTWC issued the final warning valid at 050600Z.

III. DISCUSSION

Tropical cyclogenesis induced by a TUTT cell

A persistent feature of the upper-tropospheric flow over the tropics of the WNP and North Atlantic oceans during the summer is the tropical upper-tropospheric trough (TUTT) (Sadler, 1975). In the mean, the axis of the TUTT overlies low-level easterly trade wind flow approximately midway between the axis of the subtropical ridge and the axis of the monsoon trough.

In synoptic analyses, the TUTT is commonly observed to consist of a chain of westward moving synoptic-scale cyclonic vortices called "TUTT cells" in the WNP ("upper cold lows" in the Atlantic). The typical distribution of clouds associated with a TUTT cell features a relatively small region of isolated cumulonimbi (CB) or small mesoscale convective systems (MCS) within (or very near) its core. Sometimes extensive multi-layered clouds with embedded CB and MCSs are found to its south and east. The cloudiness to the south and east of a TUTT cell in the WNP is often associated with the monsoon trough, and the TUTT cell (or a chain of TUTT cells) acts to modulate the distribution of cloudiness along the axis of the trough, and also acts to produce an accentuated sinusoidal pattern to the outflow cirrus on the northern side of the monsoon cloud band.

Sadler (1967) proposed that the TUTT (with its embedded TUTT cells) was the primary source for disturbances (e.g., inverted troughs, isolated clusters of CB, etc.) in the trade wind flow. Sadler (1967) also credits TUTT cells with the capacity to induce TC genesis. TUTT-induced TC genesis was envisioned by Sadler to be the result of the distal penetration of the TUTT cell cyclonic circulation to the lower levels, thereby initiating deep convection which, through the release of latent heat, gradually converted the TUTT cell into a warm-core low (i.e., a TC). In two later papers (Sadler 1976, 1978), the role of the TUTT (and of TUTT cells within it) is relegated to one of contributing to the development of a TC by providing a region of persistent upper-level divergence to

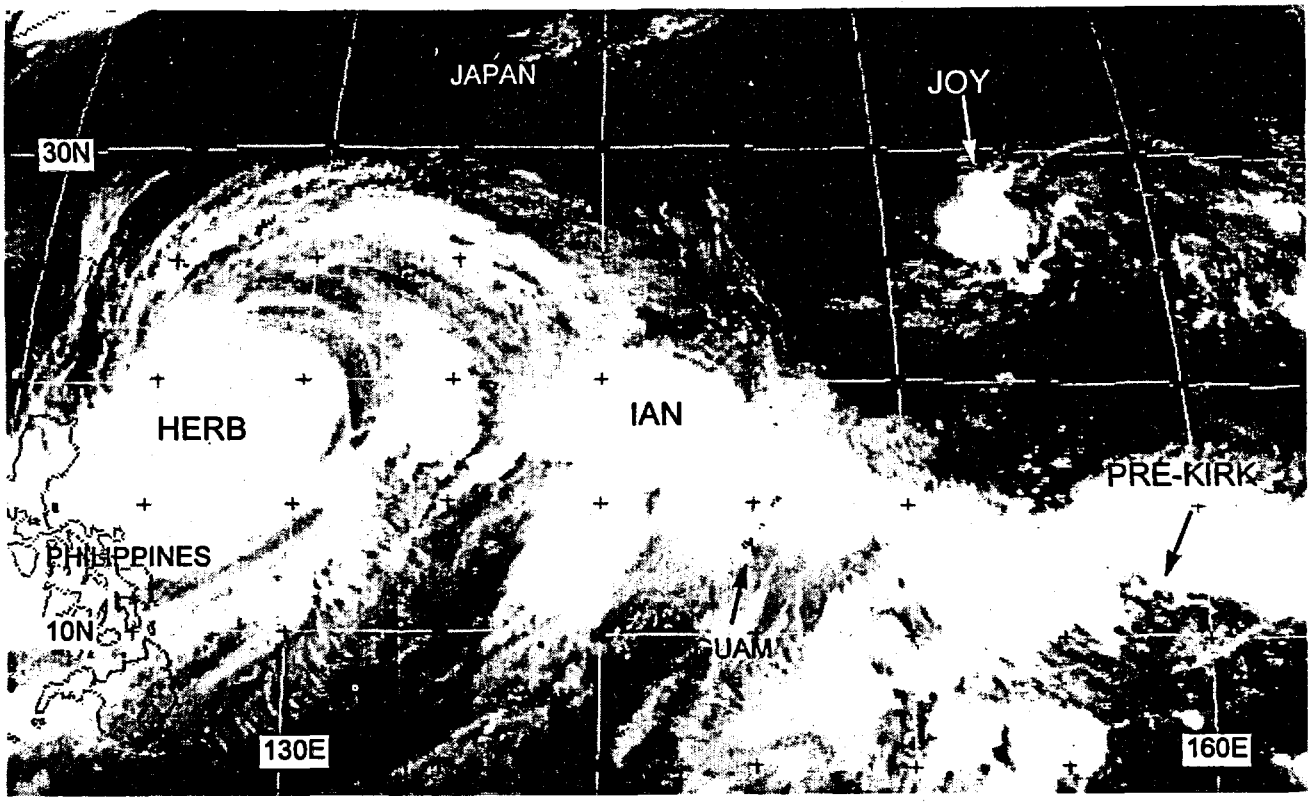

Figure 3-12-3 A characteristic typical of TUTT-induced tropical cyclones, Joy is isolated in the relatively cloud-free region of easterly low-level wind flow to the north of the monsoon cloud band (291331Z July infrared GMS imagery).

initiate and maintain deep convection. The TUTT cell also creates an efficient outflow channel for the incipient TC. In this scenario, the TC is usually located to the south or southeast of the TUTT, or a TUTT cell that propagates in tandem with it.

In our investigations of the role of the TUTT — and in particular, TUTT cells — in TC formation in the WNP, we have observed a process whereby a TC forms (sometimes rapidly) near the core of a TUTT cell. This process is similar to Sadler's (1967) distal mechanism of TUTT-cell induced TC formation. Careful observation has shown that the isolated convective cloud cluster (i.e., a mesoscale convective system) that forms a TC near the TUTT cell, does so not directly in the core of the TUTT cell, but usually within 200 to 400 km to the east through north of the upper-level circulation center of the TUTT cell where the upper-level flow is diffluent and anticyclonically curved. Also, it is here, on the northern side of the TUTT cell, that both the upper-level and lower-level flow is easterly resulting in a region of low vertical wind shear. Another typical characteristic of these TUTT-induced tropical cyclones is their isolation in the cloud minimum region of easterly wind flow to the north of the monsoon cloud band (e.g., Figure 3-12-3). The origin of Joy from a TUTT cell is well illustrated by water-vapor imagery (Figure 3-12-4a-g).

IV. IMPACT

No reports of injuries or damage were received at the JTWC.

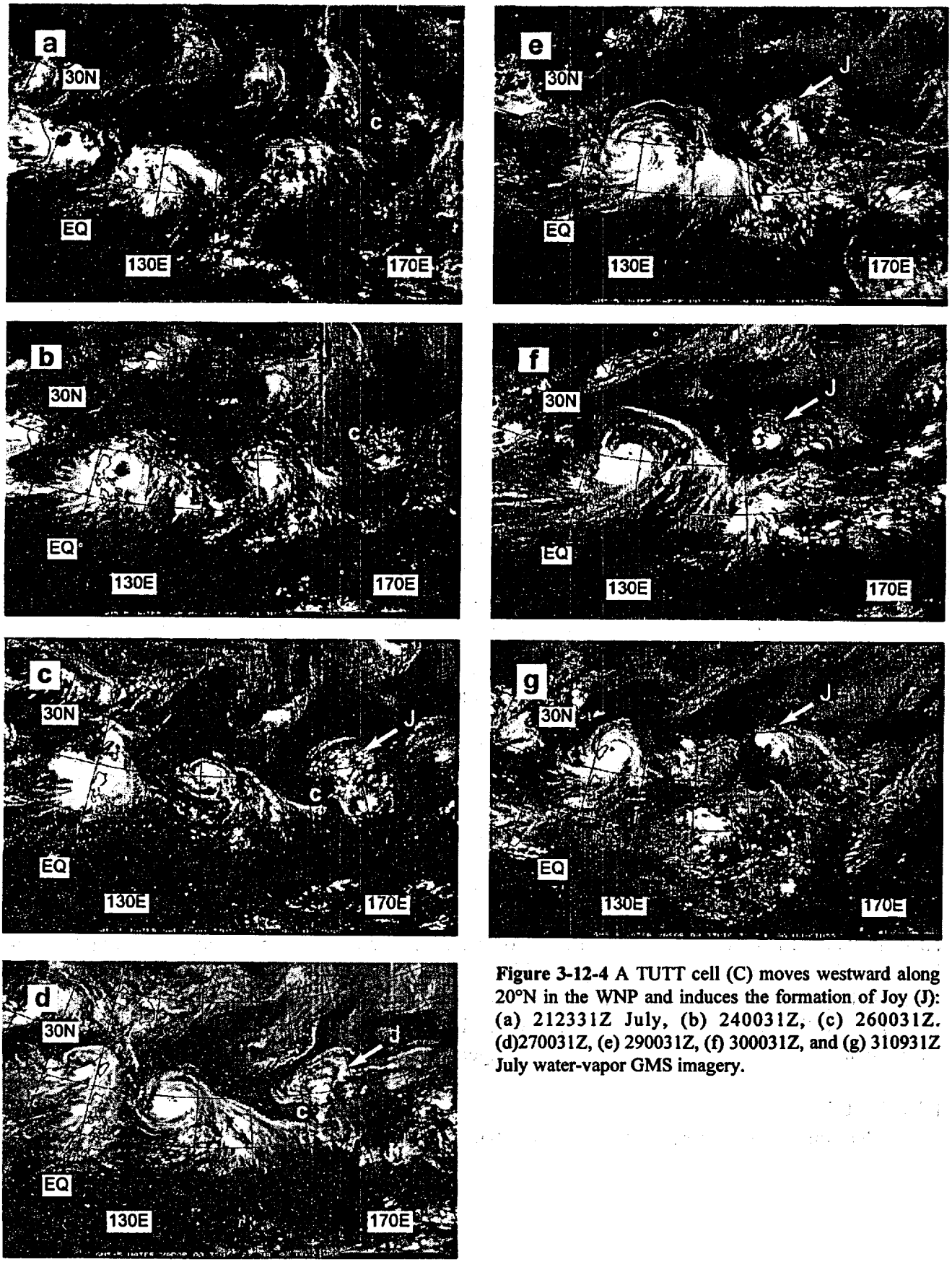

Figure 3-12-4 A TUTT cell (C) moves westward along 20°N in the WNP and induces the formation of Joy (J): (a) 212331Z July, (b) 240031Z, (c) 260031Z. (d)270031Z, (e) 290031Z, (f) 300031Z, and (g) 310931Z July water-vapor GMS imagery.